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The Habits of the Honey Bee

By
E. F. PHILLIPS, Ph. D.

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Medina, Ohio

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THE A. I. ROOT COMPANY, MEDINA, OHIO

The Habits of the Honeybee

E. F. Phillips, Ph. D.

*The A. I. Root Company, Medina, Ohio
July, 1914*

Publisher's Introductory.

The writer of the following treatise on the honey-bee, Mr. E. F. Phillips, Ph.D., is the scientist who spent nine weeks with us here in Medina investigating the honeybee during the summers of 1903 and 1904. His articles, which appeared later in *GLEANINGS IN BEE CULTURE*, added much to our knowledge of the bee. All of these articles were of a very technical nature; but in this booklet will be found in simple language the history and life of the bee. Any one without previous instruction can, by reading this booklet, gain a practical knowledge of the honey-bee.

Dr. Phillips graduated in Allegheny College, Meadville, Pa., in 1890. He taught science in the New Brighton high school for two years. He then entered the post-graduate department of the University of Pennsylvania in 1901, holding University scholarships for 1902 and 1903. He was appointed Harrison Fellow of Zoology for 1903 and 1904. Mr. Phillips is now Expert in Charge of Apiculture, in the Bureau of Entomology of the United States Department of Agriculture, Washington, D. C.

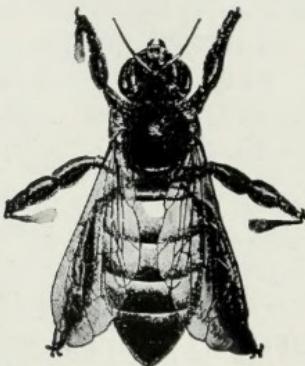
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THE HABITS OF THE HONEYBEE.

Of all the insect associations there are none that have more excited the admiration of men of every age or that have been more universally interesting than the colonies of the common honeybee. While ants, wasps, and the true ants have all come in for their share of study, and truly wonderful are the activities of their colonies; but on account of its value to man as a honey-producer the honey-bee, *Apis mellifera*, has received more attention and its habits are much better known. It would seem that, of the making of books on bees, there is no end; for in every age men have written of these insects, and at present we see more new books than ever before. Since there is so much to be written about bees, nothing but a mere outline can be expected in this article. In this case, as in all others, it is better to follow the advice of the celebrated naturalist Agassiz, "Study nature, not books," for time spent with bees in an observation hive is worth far more than time spent over bee-books, provided the observer goes at the observation in the true spirit of an investigator and does not first decide what he will see and then find it.

The ancients held many absurd views concerning the generation and propagation of bees, believing that they arose from decaying animals, from the flowers of certain plants, and other views equally ridiculous from our present point of view. The names of Swammerdam, Reaumur, Bonnet, Schirach, and Huber will

always be venerated among beekeepers for the light they threw on the activities of the hive. It would be interesting to note the discoveries of these men and their followers if room permitted. Men of the olden days were not alone in their absurd beliefs, for even at the present day there appears at times a man who thinks he has made the wonderful discovery that all our old beliefs are wrong; but we are comforted by the fact that most of these receive no following. It is



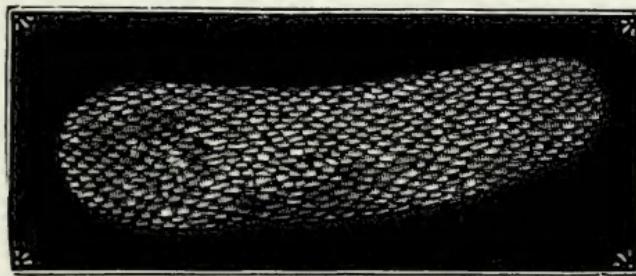
WORKER-BEE.

by this means only, however, that we are to arrive at the truth ultimately; for by sifting what is correct from all the views advanced, and dropping the errors, we shall perhaps some day know the true economy of the hive. It is scarcely necessary to remark that we are far from that position at the present time.

The honeybee belongs to the group of insects known beekeeping can soon recognize each with ease. This order includes both solitary and social bees, wasps, ants, saw-flies, and some others, all of which are interesting in their habits. This order is divided into

families, the family to which the bee belongs being known as the *Apidae*.

A colony of bees consists of one female, capable of laying eggs, called the queen; some thousands of undeveloped females that normally never lay eggs, the workers; and, at certain seasons of the year, many males, the drones, whose only duty is to mate with the young queens. These different kinds of individuals can readily be recognized by the difference in size of various parts of the body, so that even the novice at beekeeping can soon recognize each with ease. This colony makes its home in nature in a hollow tree or



EGG OF QUEEN UNDER THE MICROSCOPE.

cave; but it thrives perhaps even better in the hives provided for it by man. There are many kinds of hives —some good and others seemingly made merely to sell; but they must all contain sheets of comb, concerning the making of which more will be said later. In a modern hive the sheets of comb are placed in wooden frames which are hung in the hive-box in such a way that they can be removed at the pleasure of the bee-keeper. A sheet of comb is made up of small cells in which honey is stored by the bees, and in which eggs are laid, and young bees develop. To study the activ-

ties of the hive there is no better way to observe the bees than to keep a small colony in an observation hive. Such a hive consists of but one frame hung in a narrow hive with glass sides, so that the bees are all visible at all times. No one who is unfamiliar with such a hive can appreciate the pleasure and profit to be derived from watching a colony under such circumstances; and to any one who has the ability to appreciate the wonderful things in nature it is no hardship to spend hours by the side of the hive studying the every movement of the bees. Of course, it must be understood that there will be slight differences in the behavior of the bees in such a hive, but these are of little importance to the beginner.

Having now become acquainted with the three kinds of individuals in the colony, and the place in which they live, we will take up their habits of life. Perhaps there is no better way to arrange what is to be said on this subject than to follow a colony through a season, taking up the various phases of their actions in the order in which they occur in nature.

In the spring of the year the colony consists of a queen and workers, there being no drones present at this time of the year. During the winter the bees remain quiet, and the queen lays no eggs, so that there are no developing bees in the hive. The supply of honey is also low, for they have eaten honey all winter, and none has been collected and placed in the cells. As soon as the days are warm enough the bees begin to fly from the hive in search of the earliest spring flowers. From these flowers they collect the nectar, which is transformed into honey, and pollen, which they carry to the hive on the pollen-baskets on the third pair of legs. The nectar is taken by the bee into

its mouth, and then passes to an enlargement of the alimentary canal known as the honey-stomach, where it is acted upon by certain juices secreted by the bee. The true stomach lies just behind the honey-stomach; and if the bee needs food for its own immediate use it passes on through the opening between the two stomachs. On its arrival in the hive the bee places its head in one of the cells of the comb and deposits there the nectar which it has carried in. By this time the nectar has been partly transformed into honey, and the process is completed by the bees by fanning the cells to evaporate the excess of moisture which still remains. When a cell has been filled with the thick honey the workers cover it with a thin sheet of wax unless it is to be eaten at once. The pollen is also deposited in cells, but is rarely mixed with honey. The little pellets which the bees carry in are packed tightly into cells until the cell is nearly full. If a cell of pollen be dug out of the comb, one can often see the layers made by the different pellets. This collecting of nectar and pollen continues throughout the summer whenever there are flowers in bloom, and ceases only with the death of the last flowers in the autumn.

Almost as soon as the honey and pollen begin to come in, the queen of the colony begins to lay eggs in the cells of the center combs. The title of queen has been given to the female bee which normally lays all the eggs of the colony, under the supposition that she governs the colony and directs its activities. This we now know to be an error, but the name still remains. Her one duty in life is that of egg-laying. She is most carefully watched over by the workers, and is constantly surrounded by a circle of attendants who feed her and touch her with their antennæ; but she in no

way dictates what shall take place in the hive. The eggs are laid in the bottom of the hexagonal cells, being attached by one end to the center of the cell. The first eggs laid develop into workers, and are deposited in cells one-fifth of an inch across. As the colony increases in size by the hatching-out of these workers, and as the stores of honey and pollen increase, the queen begins to lay in larger cells measuring one-fourth of an inch, and from the eggs laid in these cells drones (or males) develop. The size of the cell does not determine the sex, as will be explained later; but the queen almost invariably lays the worker eggs in the smaller cells, and drone eggs in the larger ones. As these male eggs develop and hatch, drones begin to appear in the colony, generally about the first of May in temperate climates.

The eggs do not develop directly into adult bees, as might be inferred from what has just been said; but after three days there hatches from the egg a small white worm-like larva. For several days the larvae are fed by the workers, and the amount of food consumed is truly remarkable. The larva grows rapidly until it fills the entire cell in which it lives. The workers then cover the cell with a cap of wax, and at the same time the larva inside spins a delicate cocoon under the cap. The worker brood can at once be distinguished from the drone brood by the fact that the workers place a flat cap over worker brood and a high arched cap over drone brood; and this is often a great help to the bee-keeper in enabling him to determine at once what kind of brood any hive contains. Twenty-one days from the time the egg is laid the young worker-bee emerges from its cell, having gone through some wonderful transformations during the time it was sealed up, this

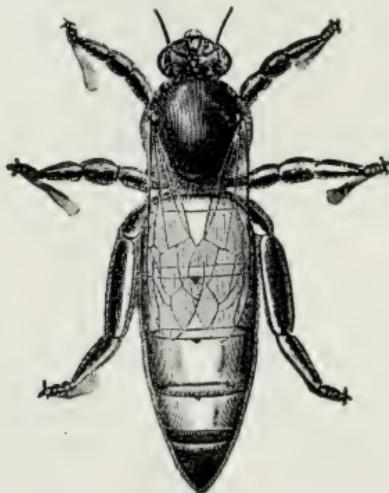
stage being known as the pupa stage. For drones the time is twenty-four days.

About the time the drones begin to appear, the inmates of the hive begin to prepare for swarming, which, to any one watching the habits of bees, is one of the most interesting things which takes place in the colony. The workers now begin to make queen-cells. In our previous description of the development of the young from the egg, nothing was said about the queen, and there are some decided differences in her growth which we will not take up.

As was stated earlier in this article, the queen and the workers are all females. Schirach, an old authority on bees, discovered that the bees could take a young worker larva soon after it hatched from the egg, and, by giving it special food all during its larval life, "royal jelly," and, by constructing for it a special cell, make of the otherwise worker larva a fully developed queen. This it is that the workers of a colony do when they are preparing to swarm. Several young worker larvæ are chosen as the material for queen-rearing, generally located near the margin of the comb. The workers now begin to feed these chosen larvæ an extra amount of food, and at the same time the sides of the cells containing them are remodeled and enlarged by the destruction of surrounding cells. The queen (or royal) cell is nearly horizontal at the top, like the other cells of the comb, and projects beyond them; but then the workers construct another portion to the cell into which the queen larva moves. This is an acorn-shaped cell placed vertically on the comb, about as large as three ordinary cells. As the cell is being built, the queen larva continues to grow until the time comes for her to be sealed up and enter her pupa state. Al-

though it takes the worker twenty-one days to complete its development, the queen passes through all the stages and reaches a considerably larger size in but sixteen days.

Before leaving the subject of the raising of queens it might be well to state that if, for some reason, a queen is killed in the hive, or by chance gets lost, the workers can at any time replace her by the same



QUEEN-BEE, MAGNIFIED.

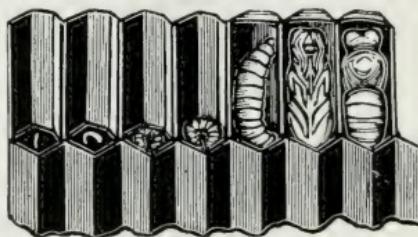
method, provided, of course, they have worker larvae on which to work. In the same way they will replace an old queen when she begins to show signs of decreased power of egg-laying, so that this peculiar performance is not characteristic of swarming only.

In the swarming season, at about the time the new queens are ready to leave their cells, the old queen leaves the hive and takes with her part of the workers, this being known as swarming. This generally takes place in the morning of a warm pleasant day. It

might as well be confessed that we know but very little about this remarkable instinct of the bee. In the first queens are ready to leave their cells, the old queen would not allow queen-cells to be constructed in her colony, nor has any one told us why she allows it now. Neither do we know what starts the actual swarming, or what bees, workers, or queen first sets the hive in motion. Neither do we know what is the thing which compels certain bees to leave with the old queen, and why the others stay in the old hive with the young queen. Here is plenty of interesting work for any one who desires to investigate some phase of the life-history of bees; and for the encouragement of the beginner it may be added that there are plenty more open fields. Since our original hive has now divided we will follow the swarm with the old queen, and, later, return to the old hive to observe the actions of that.

In the hands of a beekeeper the departing swarm will be put into another hive provided he wishes to increase the number of his colonies; but in a state of nature the swarm will find an old hollow tree or some similar place in which to establish itself. The bees, before leaving their old hive, fill themselves with honey until the abdomen is greatly distended, and for this reason it is not necessary for them to collect nectar for a day or two, for they have other work to do. Some of the bees begin to clean out the new quarters and get it fit for occupancy; but most of them begin the construction of new combs. To do this they suspend themselves in curtains from the top of the hive, and remain motionless for some time. The wax used in building comb is secreted by the workers in eight small pockets on the lower side of the abdomen while they

thus hang in curtains. Finally, after enough wax has been formed, they begin to build. The small flakes of wax are passed forward to the mouth, there mixed with a salivary secretion to make the wax pliable, and then are placed on the top of the hive by the first comb-builders. Other workers then come and place their small burdens of wax on those first deposited, and this continues until the combs are finished. There is more to comb-building than the mere sticking on of wax plates, however; and nothing in all bee instincts is more wonderful than the beautiful plan on which



GROWTH OF LARVAE.

they build the comb. The cells are hexagonal in shape, so that each cell in the center of the comb is surrounded by six others. Nor is this the only remarkable thing in their architecture, for each comb is composed of a double row of cells, the base of each cell being formed of three parts, each one of which is likewise a part of a separate cell of the other side of the comb. By this method the bees obtain the greatest possible capacity for their cells, with the least expenditure of wax. The accuracy of the cells of the comb has in all ages been an object of admiration of naturalists and beekeepers; and while the degree of perfection assigned to these cells has undoubtedly been overstated by many writers,

yet we cannot but admire and wonder at the remarkable instinct, almost bordering on intelligence, which enables the bees thus to build cells so well suited to their purpose.

The original plan for a cell for storing honey and raising brood is a cylinder, and this we find in some other bees; but if the honeybee constructed cylindrical cells there would be much more waste space and an unnecessary expenditure of wax. If we take a number of cylinders of flexible material and press them together they assume a hexagonal shape like the cells



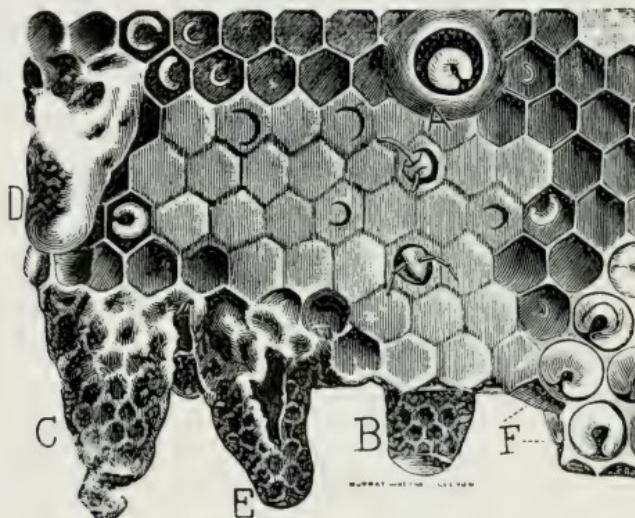
DRONE-BEE—NO POLLEN-BASKET.

of the comb; but the bees in building do not first construct cylinders, but at first hand make the cells hexagonal.

As soon as there are some cells constructed, and even before the cells are entirely completed, the queen begins to lay eggs, and the workers begin to collect the stores of honey and pollen. They also collect in considerable quantity a waxy substance from various

trees, commonly called propolis, with which they seal the inside of the hive, closing up all openings except the one which serves as the entrance.

On a previous page mention was made of the two sizes of cells in the comb. The earliest cells constructed by a swarm are always worker-cells—that is, cells from which workers will hatch, and these occupy the middle space of the hive. Later on, the workers con-

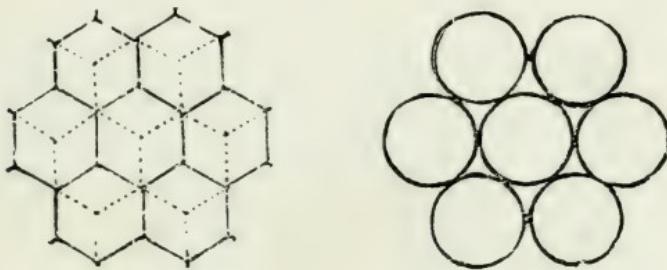


QUEEN-CELLS.

struct comb with cells of the larger size, from which drones hatch when they are used for brood, and in which honey is stored. The cells which are used for the storing of honey generally slant upward slightly to help keep the honey from running out. This mars to some extent the symmetry of the comb, but adds greatly to its efficiency. Queen-cells are made only when a new queen is to be reared.

In this way the new swarm prepares for itself an abode like the one it left; and by sealing up the crevices and gathering stores of honey it prepares itself for the coming winter. We may now return to the colony which remained after the swarming took place, to see what takes place there.

The colony left in the old hive retains all the brood and honey stores, and has a newly hatched queen. There is then no necessity for wax-building nor for sealing up the hive; but this colony is already in a normal condition except that the queen is not yet ready to perform her duties, and she will receive our atten-



HEXAGONAL AND ROUND CELLS.

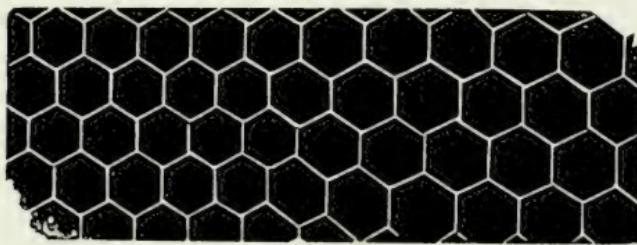
tion now. A very young queen receives little attention from the workers, but goes about the combs practically unattended. When about five days old (the exact time depending on the weather), in the afternoon the virgin queen flies from the hive to mate with a drone, or male. She first takes several small preparatory flights to get her hive located so that she may find it on her return, and finally she flies upward in constantly enlarging circles high in the air. This far she may be easily followed; but few have been fortunate enough to observe the actual mating. Sometimes the mating

takes place at a lower point, and a few men have recorded the fact of witnessing the completion of the "marriage-flight." The queen, on leaving the hive, in some way attracts a great many drones to her from all parts of the apiary, provided her hive is located in a bee-yard, and the swiftest and strongest drone is successful in the race. The other drones often follow the queen back to her hive, and for an hour or two often remain on the outside of the hive after she has entered, but later they return to their own hives.

The queen returns from the mating-flight in about half an hour, carrying with her the generative organs of the male which is killed during the union of the two. Near the posterior end of the queen is a small sac, which, before the flight, is filled with a clear liquid; but after her return this sac is filled with an opaque fluid; and it is the reception of this opaque substance which is the essential thing in mating. This liquid contains millions of spermatozoa, or male-sex cells, each one of which is capable of fertilizing an egg as it glides past the opening of the sac. This supply of spermatozoa is almost always sufficient to supply the eggs laid by a queen for three or four years, it rarely happening that she mates the second time before laying. There may be cases in which she mates after once beginning to lay, but the evidence for such a flight is very small. Since a queen can, during her lifetime, lay a total of 500,000 eggs, most of which receive one of these spermatozoa, it will be seen that the apparatus for preserving them is very perfect, since the queen cannot generate more, and they do not divide or increase in number in any way.

The mating of queen and drone never occurs in the hive, but always in the air, on the wing. This instinct

prevents what is known as in-and-in breeding; for if the queen mated in her hive she would receive spermatozoa from her brothers or from her sons, and we know that such close breeding is undesirable in all forms of life. The cause of the undesirable results of in-breeding are yet a mystery; but we do know that they follow, and this habit of the queen in mating away from her own hive renders close crossing less probable. After the queen has returned to her hive, the workers remove the male organs. These parts of the male are not absorbed by the queen, as is sometimes claimed; but the spermatozoa contained in them are taken into the spermatheca, or spermatozoon-sac,



WORKER AND DRONE CELLS.

and the rest dries up and is removed. Almost as soon as the queen returns from her flight there is a difference in the treatment which she receives from the workers. It happens at times that she is not received kindly after taking her flight, and may be killed by the workers, which do not recognize her as their queen, probably on account of some new odor which she has acquired during her absence. This is rare, however; for, ordinarily, she is the object of much care and attention on her return. From this time on, whenever the queen stops for a moment on the comb, either to

deposit an egg or to rest, she is surrounded by a dozen or so workers that try to feed her, and who rub her with their antennæ. In about two days after mating, the young queen begins to lay eggs in the cells of the comb, and this one duty, and no other, she performs until her death, never again leaving the hive except at the head of a swarm.



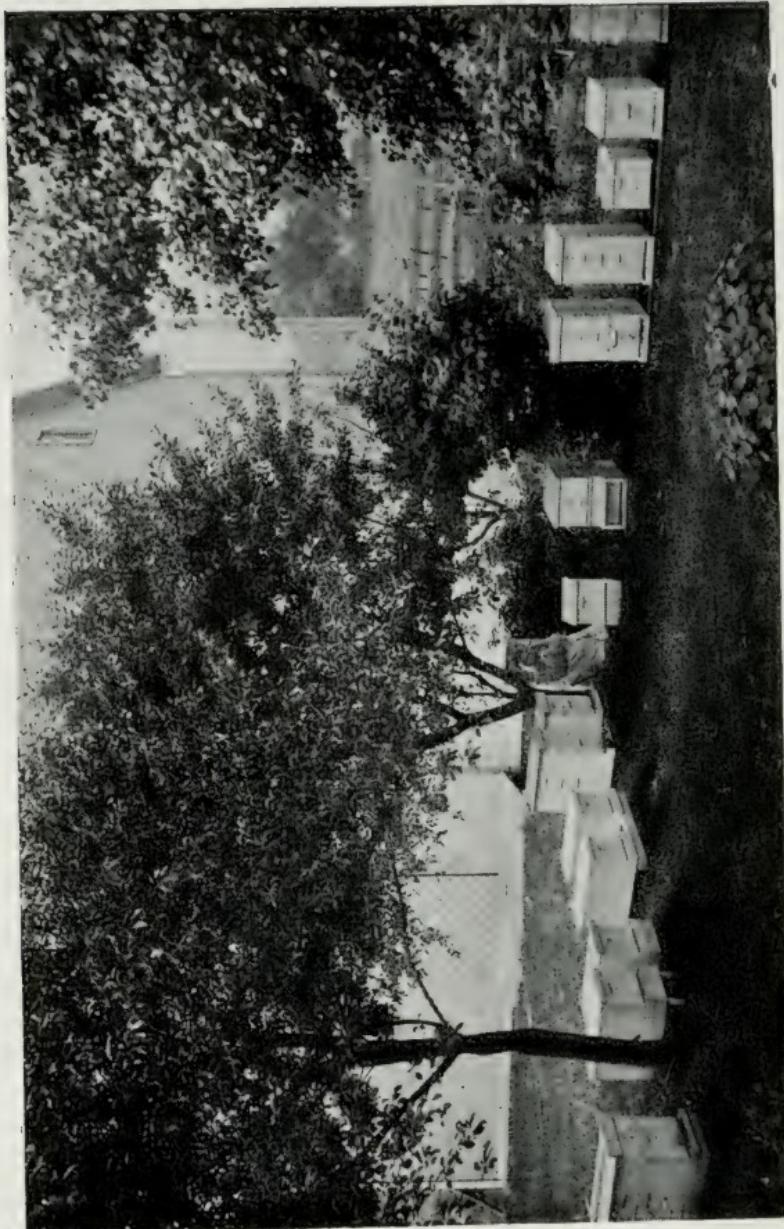
THOSE PETS.

The colony with the young queen is now in the same condition as the one which left the hive, both having laying queens, combs, brood, and a sealed hive. Their histories, under normal circumstances, are then practically the same. Both prepare for winter, and the following spring both cast swarms again, and the

cycle is again repeated. Such is the activity of bees under favorable circumstances; but, needless to say, this ideal condition is not always realized, and we will now follow colonies under other conditions to see what happens.

Let us take a colony with a virgin queen like the one left after the swarm was cast. It sometimes happens that the queen is defective in some way, so that she can not fly from her hive to meet a drone. This may be caused by mutilated or weak wings, or possibly the queen shows no disposition to fly. On the other hand, the weather may not be favorable for her flight, or there may be drones in the air when she does fly. Evidently, any of these conditions will prevent successful mating; and when this occurs we are enabled to see one of the most remarkable phenomena of the hive. The observer who wishes to study this phase of bee activity may bring about the same conditions by cutting off the wings of the queen, or by covering the entrance with zinc perforated with holes, which allows the workers to pass freely, but which confines the queen to the hive, so that it is not necessary to depend on chance to bring about what we are now to observe.

If a queen remains unmated for a period of three weeks she is incapable of mating, and loses all desire to leave the hive to meet a drone. After that time she may begin to lay eggs, but, strangely enough, these eggs produce nothing but drones, and the queen is then known as a "drone-layer." Obviously, then, drones are produced from eggs which have not been fertilized. Not all unmated queens become drone-layers; in fact, many queens die if not mated, and many others never lay at all; but if any eggs are laid they produce only drones. The person wishing to verify this strange



APIARY OF CHARLES G. MACKLIN, MORRISON, ILLINOIS.

phenomenon should start several virgin queens in hives, and probably one or two will lay.

This introduces us to one of the most remarkable phenomena which is known to occur in nature, but it is not characteristic of bees alone. In most cases eggs disintegrate unless fertilized by spermatozoa of the same species. Just why fertilization is necessary is still a disputed point among scientists; but we know that it is by all means necessary in the majority of cases. Yet in many cases in the animal kingdom eggs do develop without fertilization, and one of the best known cases is the development of the drones of the honeybee. To this phenomenon the name "parthenogenesis" is applied.

This fact concerning drones was discovered by Johannes Dzierzon in 1845, and has since been verified by many workers on the subject. As the eggs in the queen leave the ovaries they pass down a tube called the oviduct, to the outside. As they traverse the oviduct they pass the entrance to the spermatheca mentioned above; and if the egg is to become a female, worker, or queen, it receives from the spermatheca one spermatozoon which fertilizes it; if it is to become a drone it receives no spermatozoon, and, consequently, is in the same condition as are all the eggs of a drone-layer. Since a normal queen rarely lays a drone egg in a worker-cell, or *vice versa*, provided both kinds of cells are present, it would seem that she in some way can control the spermatheca; but how this is done is still a mystery.

Another fact which supports the theory of parthenogenesis is that workers in a colony which is hopelessly queenless will often begin to lay eggs. As we have seen, workers as well as queens are females, but

they are incapable of mating, and the eggs laid by them produce nothing but drones. This entire subject of the parthenogenetic development of the drones is still but little understood, and here again is a wide field of work for one who is willing to devote time and energy to the subject. A few facts are well known; but around these facts there has been woven a mass of good or bad guesses which must be verified before we arrive at the truth. If the theory could be stripped of these surmises the whole subject would be much clearer; and one who undertakes to work on this line must drop all but well-verified facts. The A. I. Root Company has published in booklet form "The Dzierzon Theory," by Baron von Berlepsch, which was translated into English by Samuel Wagner, and published in the *American Bee Journal* for 1860. This booklet contains a fuller discussion of the facts supporting this theory, and should be consulted by any person interested in the subject.

Colonies containing drone-laying queens, or workers which lay eggs, called fertile workers, can naturally not become strong, since no new workers are produced to do the work of the colony; and as the old workers are killed, or die off in a comparatively short time, the colony soon dies out, since the drones produced do no work. This can be prevented by the owner of the hive by introducing a new fertilized queen to the colony, but, of course, in nature the fate of the colony is sealed.

Having followed the course of normal and abnormal colonies during a season we are now ready to see what takes place in preparing for winter. The entire hive is filled with honey, the drones are expelled from the hive, and die, and the queen ceases to lay eggs. When

cold weather comes on, the bees cluster together on the combs and are in a very inactive condition, merely doing enough fanning to keep up the temperature of the hive. During the winter the stores of honey are consumed, and generally in the spring but little remains. On a bright warm day in winter the workers may take short flights from the hive, but for short distances only. After the winter is over they once more begin the cycle described above, and year after year this goes on to the pleasure and profit of the beekeeper.

In the previous discussion of the habits of the bee the practical side of beekeeping has been entirely omitted, for it is the purpose of this article to give a brief introduction to the actions of these insects in their natural conditions. Modern apiculture is made possible by numerous appliances which add greatly to the ease with which bees can be handled, and also add even more greatly to the profit to be derived from the care of bees; and a knowledge of practical beekeeping adds greatly to one's knowledge of the habits of bees as well as makes possible many interesting experiments after new facts. By modern methods we are enabled to take honey from the bees without resorting to the old methods of killing the entire colony; we can raise queens at pleasure, and in any number, by bringing about artificially the conditions under which queens are produced; we can extract the honey from the combs by centrifugal force, and return the combs to be refilled; and numerous other operations almost indefinite in number are possible as a result of the careful work of practical beekeepers. A discussion of these methods is just as interesting as the account of the natural instincts of the bee, but is out of place in

an article of this size. The reader is referred to any one of the numerous books on practical apiculture for full details concerning these methods.

Nor must it be supposed that the natural actions of the bee have been exhausted in what has been written. As stated in the first paragraph, volumes have been written on bees and their habits, and this is but a skeleton outline on which far more interesting facts can be built. The senses of bees, especially the sense of smell, the structure of the different individuals, and the adaptations of the parts to the work required of each, the natural enemies of bees, and their methods of defense—these are but a few of the subjects which might be discussed with profit, to say nothing of fuller discussions of subjects which have been merely suggested in the preceding outline. It is a noteworthy fact that every person who studies or works with bees becomes enthusiastic on the subject; and in this brief article should induce some one to take up this line of work the object of the article will be fulfilled, and the new apiarist may be assured that he is entering into a most entrancing field of work.

And, finally, there still remains much to be learned about the bee from careful and painstaking observation; and by such work the cause of apiculture and science at large will be much benefited. In several places mention has been made of unsettled problems; but the number could be extended very greatly, and each new discovery opens up new fields of work. Here, then, is work for those who wish to add to the sum of human knowledge in a line of work which can be of the greatest practical use to mankind at large.

Publications on Bee Culture

The pamphlets and booklets listed below are of more than ordinary interest. Look over the list, check the ones you want and we will send them at once. Of course you will include remittance for those for which there is a charge.

MY FIRST SEASON'S EXPERIENCE WITH THE HONEYBEE. By the "Spectator" of the *Outlook*, New York. A ten-page leaflet detailing the experiences of this well-known writer. You will read it through before you lay it down. Free.

THE BEEKEEPER AND FRUIT-GROWER.—A booklet giving actual facts regarding the value of bees to fruit, and showing how beekeeping may be doubly profitable to the fruit-grower. Free.

BEEKEEPING FOR SEDENTARY FOLK. Recites the actual experiences of an amateur beekeeper. Free.

TRANSFERRING BEES. A booklet which gives instructions and illustrates appliances. If your bees are in old box-hives you are not getting half that you could out of them, and this booklet will tell you just how to transfer them to modern hives. 10 cts.

THE A B C OF BEE CULTURE. A complete text book of over 500 pages, giving full information on every question relating to bees. Valuable to the beginner and indispensable to every beekeeper. Price \$2.00 postpaid.

CATALOG OF BEEKEEPERS' SUPPLIES, with complete information, mailed free to any address.

Please send me the items checked above. I enclose \$..... to cover the cost.

Name

P. O.

..... State

The Root Observatory Hive



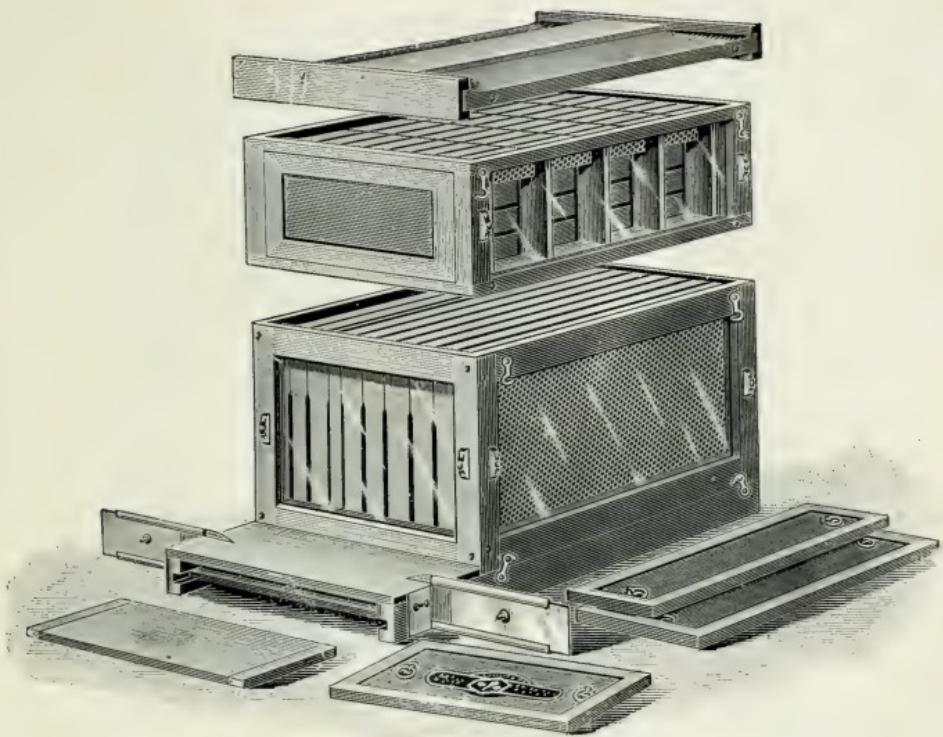
To meet the increasing demand for a moderate-priced Observatory Hive, for use in schools and homes, we have decided to manufacture the style illustrated herewith. This hive is identical with our regular, with the exception of the body and super sides, which are fitted with glass, together with wooden shutters for closing the hive while not observing. This hive permits the keeping of a regular colony of bees in a normal condition so that every phase of beekeeping may be studied.

PRICES.

| | |
|--|---------|
| Full-size L. hive, nailed, varnished, glass—no bees..... | \$ 9 00 |
| Same ready for use, Italian bees, brood, queen..... | 20 00 |
| One-frame hive, no super, nailed, varnished, glass—no bees | 3 50 |
| Same ready for use, Italian bees, brood, queen..... | 9 00 |
| One-frame hive and super, nailed, varnished, glass—no bees | 4 00 |
| Same ready for use, Italian bees, brood, queen..... | 10 00 |

The A. I. Root Company, Medina, Ohio

Factory and Main Office



The above engraving shows the various parts of the Root Observatory Hive. The sections for honey are of the most approved pattern. The frames in the brood-chamber are the Hoffman, which are the easiest handled. The glass is of the best grade, allowing an unobstructed view of the inside of the hive. The panels have handles and catches. The cover, super, body, and bottom-board can be securely fastened with catches, which prevents any accidents.

Testimonial

Our observation hive and bees arrived in fine condition, and we transferred the bees in the yard, with the whole room of forty boys and girls standing around them. The day was cool and many bees dropped to the ground, apparently dead, but the children found if they held them in their hands and breathed on them that they would revive, so it ended by boys and girls having hands full of crawling bees. The bees were gentle as could be. and now the children are not afraid of them, and if one gets on the window in the room, a boy will pick it off and put it out. To say that we are pleased is putting it mildly; we are delighted.

Very truly,
Cleveland, Ohio.

MISS OBERHOLTZER,
Teacher Lakewood Central School.

How to Keep Bees

By
Anna Botsford Comstock



WHAT are the requirements for beginning beekeeping? This is one of the most frequent questions we have. We can answer most effectually by referring our friends to the above-mentioned book by Anna Botsford Comstock. Mrs. Comstock is a writer of merit, anything she has to say is worth reading. Her own experiences as a beekeeper are most interesting, and she has told them in such a way that the beginner gets a great deal of valuable information by reading her book.

It is not a technical treatise on the subject, but a simple story of the triumphs and defeats of the author. You may profit by her successes and avoid her mistakes. Whether you have bees, expect to keep them, or are merely interested, we are sure you will enjoy reading this book. Price \$1.00 postpaid. Or you can get it in connection with a year's subscription to GLEANINGS IN BEE CULTURE for \$1.50. See opposite page for particulars regarding GLEANINGS.

THE A. I. ROOT COMPANY
MEDINA, OHIO

Gleanings in Bee Culture

Every beekeeper, large or small, ought to read one good bee-paper regularly, and, of course, he will want GLEANINGS. It is the largest bee-paper in the world, and publishes the latest and best of everything pertaining to bee-keeping from all parts of this country and from foreign fields as well. Well-known beekeepers of long experience are regular contributors, and any thing new in the bee-keeping world receives careful attention from our editorial staff. Different methods are discussed and new appliances exploited, so the beekeeper who would be really up to date must read GLEANINGS.

There is a great deal of interest, too, in our Poultry, Garden, and Home Departments, edited by our Mr. A. I. Root. Mr. Root is pretty well known to beekeepers all over the world. He spends a great deal of time now in making experiments with different poultry appliances and systems, and gives the readers of GLEANINGS the benefit of his findings. Many of our readers consider his Home Department the most valuable part of our paper, and subscribe to it for that alone. There is something of interest for every one. The subscription rate is \$1.00 per year or 25 cents for a six-months' trial.

The A. I. Root Co., Medina, Ohio:

*Enclosed find remittance for \$.....for
which please enter my subscription to Gleanings
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Name

P. O.....

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ROOT'S GOODS

The name of "Root," when applied to bee-supplies, means as much as "Elgin" when applied to watches.

When you buy "Root's goods" you are sure of goods made by skilled workmen, from the best material. You are never disappointed by receiving goods inaccurately cut, roughly made from inferior stock.

There is nothing that an apiarist needs that we cannot furnish, from a complete outfit to the smallest single article.

We began the manufacture of bee-supplies forty years ago, with an increasing trade each year, until now we are the largest concern of the kind in the world.

Our prices are right. You can buy our goods near at home. Write for catalog and name of agent nearest you.

THE A. I. ROOT COMPANY, Medina, O.

New York Chicago Washington Des Moines

Lessons in Beekeeping

**BY
MAIL**

There is now, and has been for years, a greater demand for experienced bee-help than there are men ready for these places. Each winter and spring we are obliged to disappoint many large apiarists by telling them we do not know where suitable help can be found. We have found that many who take our course in bee culture by correspondence prefer to go into business for themselves, so we still need active young men who have a fair knowledge of the subject—men whom we know something about—who can be recommended for the places frequently offered. We have, therefore, determined to offer a liberal course in

Beekeeping by Mail

We shall designate this as course No. 2. The lessons are identical with lessons in course No. 1. The time, however, is limited to one year from enrollment. The course may be easily completed in three to four months. The following is the

Outline of Course No. 2

Seventeen Lessons

- | | | | |
|----------------------------|-----------------------|-------|-------------------------|
| I. | Definitions of Terms. | IX. | Rendering Normal. |
| II. | Inmates of the Hive. | X. | Preparing for Winter. |
| III. | Comb. | XI. | Wintering. |
| IV. | Handling Bees. | XII. | Spring Management. |
| V. | Transferring. | XIII. | Bee-diseases, Symptoms. |
| VI. | Building up Colonies. | XIV. | Enemies of Bees. |
| VII. | The Honey-flow. | XV. | Establishing an Apiary. |
| VIII. | Swarming. | XVI. | Queen-rearing. |
| XVII. General Examination. | | | |

Terms of Course

Complete course, as outlined, lessons, personal answers to all questions, including the A B C of Bee Culture (720 pages), and GLEANINGS IN BEE CULTURE (semimonthly) for one year, \$5.

With either the A B C or GLEANINGS omitted in case you have one, \$4.00.

With both omitted in case you have both \$3.00.

Satisfaction guaranteed.

Use form on following page.

The A. I. Root Company, Medina, Ohio

.....191.....

THE A. I. ROOT CO., Medina, Ohio::

Enclosed find.....in payment of one complete course
of instruction No. 2 in the Root Correspondence School of Bee Culture.

Name.....

P. O.
State.....

County or Street.....
- Exp. Office.....

PLEASE ANSWER THE FOLLOWING: Have you a colony of Bees?.....

Have you an A B C' of Bee Culture? if so, what year published?.....

Are you at present a subscriber to Gleanings?.....

A Kind Word

I received the last shipment today and they were all right. Every thing came that we had ordered in good shape.

O. C. Hope.

Irwin, O., June 12.

From the Other Side of the World

Will you kindly bring my thanks to Mr. A. I. Root for the sending of two dasheen bulbs, which arrived in perfect order? As we are going into winter just now, I will try to keep the bulbs till early spring, which comes in the first days of August.

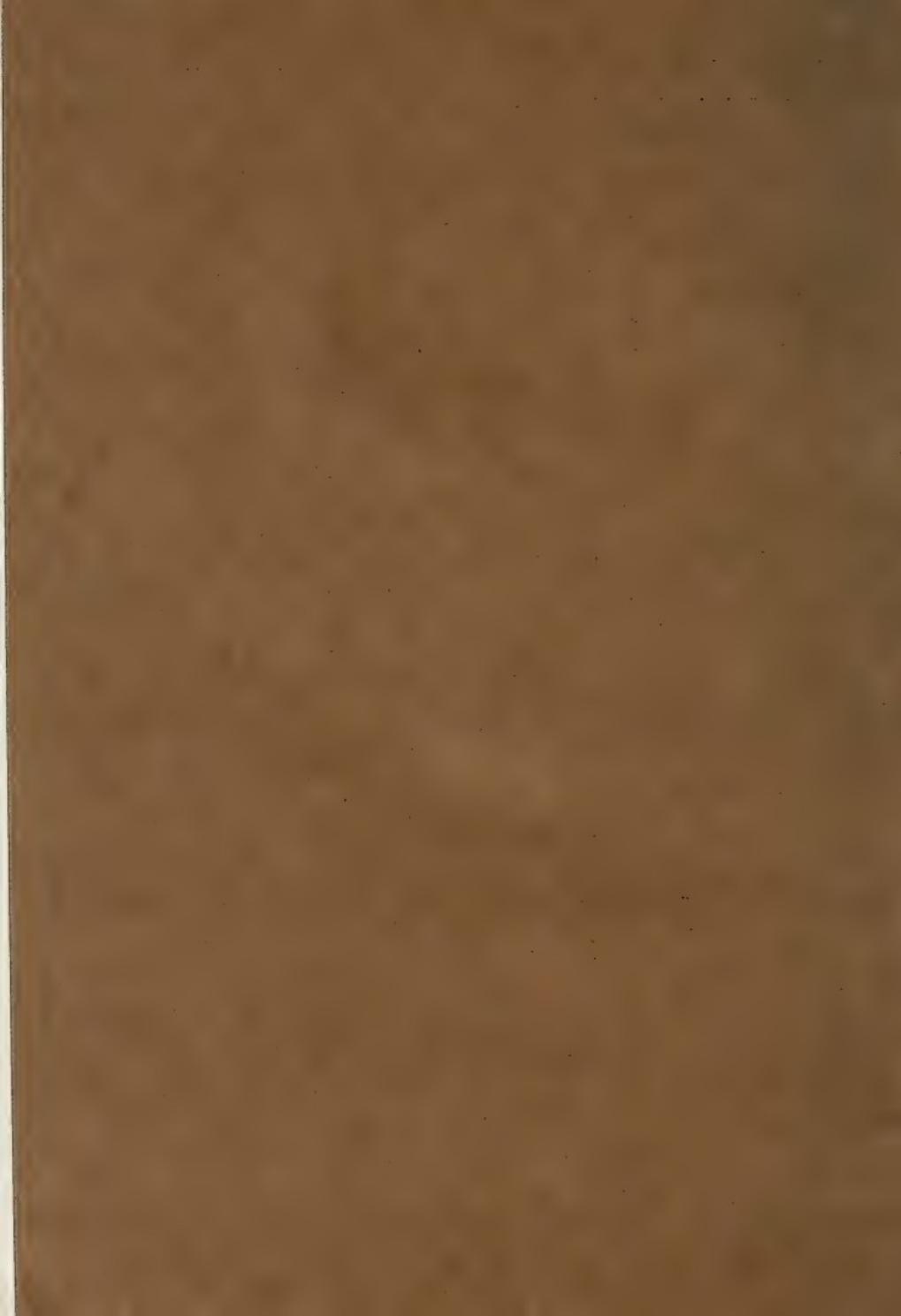
C. H. W. Kehrer.

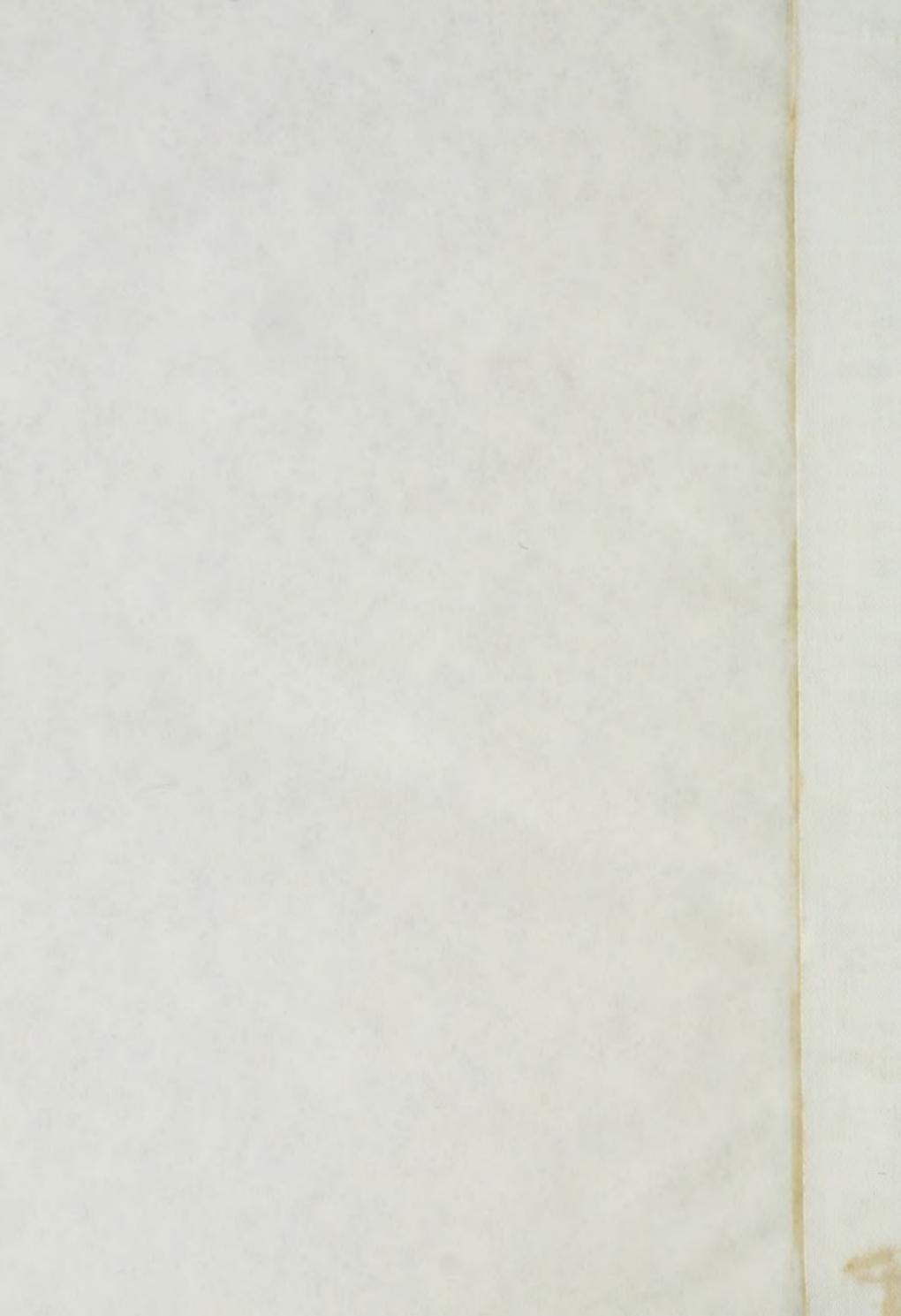
Rushenburg, Africa, April 19.

These frames are a delight. There is no kick coming on any thing from your house so far.

J. L. Pledger.

Alexandria, La., June 9.





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